LAW OFFICES
STEVEN R. RIVKIN
SUITE 1200
1401 NEW YORK AVENUE, N. W.
WASHINGTON, D. C. 20005
202 783-7888

RECEIVED
JUN - 5 1992
FEDERAL COMMUNICATIONS COMMISSION
OFFICE OF THE SECRETARY

June 5, 1992

Ms. Donna R. Searcy,
The Secretary
Federal Communications Commission
1919 M Street, N.W.
Washington, D.C. 20554

Re: Notice of Proposed Rule Making in ET 92-9

Dear Ms. Secretary:

I enclose for filing in the above-captioned rule-making an original and five copies of Comments of Steven R. Rivkin, Esq. by which I tender for the record of this proceeding two articles I have recently published in the journal Public Utilities Fortnightly.

Also, I enclose an additional four copies of this filing, which (as discussed earlier today with Bill Caton of your office) I would like to have distributed personally to the members of the Commission (other than the Chairman).

If there are any questions, please contact me as shown above.

Sincerely,

Steven R. Rivkin

Steven R. Rivkin

Enc.

No. of Copies rec'd 0+9
List A B C D E

Before the
FEDERAL COMMUNICATIONS COMMISSION
Washington, D.C. 20554

RECEIVED

JUN - 5 1992

FEDERAL COMMUNICATIONS COMMISSION
OFFICE OF THE SECRETARY

In the Matter of Redevelopment of Spectrum to Encourage Innovation in the Use of New Telecommunications Technologies	ET Docket No. 92-9

COMMENTS OF STEVEN R. RIVKIN, ESQ.

In the May 1, 1992 issue of the magazine Public Utilities Fortnightly the undersigned (an attorney in private practice in Washington, D.C.) authored the enclosed "Perspective" entitled "FCC to Electrics: Move, Use, or Lose!" The article strongly endorsed the FCC's within rule-making initiative, suggested (among other things) that electric utilities would do well to convert any payments they might receive from marketplace transactions to re-allocate spectrum into equity in the providers of new services, and further suggested that the utilities themselves become "anchor tenants" of new services to gain the economically significant, highly beneficial efficiencies that local-loop telecommunications can achieve for the utilities and their customers.

The concept of utilities as "anchor tenants in the local-loop" was developed earlier in another article I wrote in the same magazine -- "White Knights for Fiber Nets: How Electrics Can Help Telcos Build Fiber to the Home," which was published August 16, 1990. I herewith tender copies of both articles for the record in this proceeding.

Respectfully submitted,

June 5, 1992

Steven R. Rivkin

Steven R. Rivkin, Esq.
LAW OFFICES OF STEVEN R. RIVKIN
1401 New York Ave., N.W. Suite 1200
Washington, D.C. 20005
(202) 783-7888

PERSPECTIVE

FCC to Electrics: Move, Use, or Lose!

By Steven R. Rivkin

The Federal Communications Commission (FCC) announced on January 16 that it hopes to foster a takeover by "emerging telecommunications technologies" of radio frequencies now licensed to the nation's energy utilities.

Specifically targeted is 220 megahertz (MHz) of microwave spectrum in the range between 1.85 and 2.20 gigaherz (GHz), a segment of spectrum which electric utilities now use for "protective relaying," forwarding critical telemetry, controlling mobile base stations, and long- and medium-haul data and voice telecommunications.

In its Notice of Proposed Rulemaking in ET Docket No. 92-9, the FCC suggests, provisionally, that these functions can be moved to other parts of the spectrum with minimal difficulty and cost. The agency finds that the public interest requires making room in an orderly and deliberate way for a variety of new applicants for broadcast spectrum who, as newcomers, have nowhere to go for now. These new telecommunications services promise major benefits for society and the economy and important new markets for American-manufactured radio equipment.

Included are: personal communications services (PCS) and personal communications networks (PCNs), which will greatly expand the versatile applications for wireless, untethered telephony that have become hugely popular and economically beneficial in the form of both cellular and cordless telephones; data PCS (computer-to-computer networking without hard-wire connections); mobile-satellite service; digital audio broadcasting; and low-Earth orbit satellites. Disadvantaged will be those microwave-based services of electric and natural gas utilities and petroleum pipelines, which now primarily link fixed sites. The FCC considers these to be uneconomic applications because they can be served as well, or even better, over fiber optic land-lines and/or via other, less uniquely desirable segments of the radio spectrum.

Along with its decision, the FCC issued a 35-page staff engineering study which finds that no other slice of the spectrum is comparably suitable for introducing these new radio applications and that the displaced applications could be relatively cheaply carried out (given time to adjust and amortize existing plant) by other telecommunications techniques. The FCC's announcement focuses on its need to devise practical and fair procedures to implement this shift — how to sort out the many and various new uses for which spectrum is sought, how to provide for the orderly removal of incumbents and their relocation to other frequencies and other media, and how to pay for the costs involved.

Significantly, the FCC proposes that "market forces" be relied on to speed and smooth the process by allowing "providers of new services assigned spectrum allocated to the new emerging technologies bands to negotiate financial arrangements with existing licensees. This would encourage reaccommodation and underwriting of the costs of transition for the 2 GHz users."

Notwithstanding the agency's deliberate care to sanction such buy-outs as the means to smooth the transition for the energy utilities to fiber optic and other microwave services, the proposal has been treated as anathema by many utilities, both before the FCC and in Congress. This conspicuous showing of dismay has been orchestrated openly by the industry's long-established representative, the Utilities' Telecommunications Council (UTC). Well before the date set by the FCC for receiving comments (June 5), the UTC began to line up its guns against the commission's initiative.

I believe that this policy of adamant opposition to constructive change is short-sighted and will ultimately harm the long-range interests of both American electric utilities and of consumers. As a practitioner before the FCC, I may be unduly impressed by that agency's conscientious grasp of telecommunications policy issues — the reason Congress has historically deferred to the FCC, ever since passage of the Communications Act of 1934 recognized that the "dynamic" nature of telecommunications technologies requires expert regulation.

In any event, I have frequently advocated a much larger reliance by electric utilities on modern telecommunications than has traditionally been the case, because their facilities can run much more efficiently and beneficially through such logical applications of local telemetry as "spot-pricing" to the consumer, distribution automation, and home automation. I believe that, at one and the same time, the electric utilities should utilize telecommunications aggressively and take on useful and profitable roles helping develop the telecommunications infrastructure now urgently needed to meet the nation's pressing, unmet requirements. The opportunity is *now* at hand.

The FCC's strategy to nudge utilities off of underutilized microwave frequencies envisages that newcomers might pay the incumbents to move over and incur new costs. Since many utility uses for spectrum can also be served — even better — by fiber, a pool of capital to finance deployment of fiber would thereby be created. (This assumes such financial inducements are needed to get electric utilities to commit to fiber. This has actually begun to occur already as utilities move to put fiber in the groundwire of *transmission* systems — much of which is being profitably leased out to interexchange telecommunications carriers and, to a lesser extent, in urban business districts to alternate access carriers.)

Equally important, such a market relationship creates an unprecedented opportunity for electric utilities to join with the "providers of new [microwave] services" in cooperatively developing microwave radio services in *local distribution*. Indeed, joint ventures can come about merely by the utilities' electing to convert any cash payments they might negotiate into equity investments in the new service providers.

A joint venture would be fortified financially and in the eyes of state public service commissions by the utility undertaking to procure reliable, dedicated telecommunications from the new service provider — i.e., telemetry that would improve the utility's operating efficiency and develop conservation options for consumers. On the electric side, these applications would be helpful and directly relevant to the state regulators' concerns with issues of cost accounting and diversification. With "incentive regulation" strategies now moving into place throughout the country, a secure, cost-effective application of local telemetry to achieve energy conservation could result in favorable regulatory treatment.

In this way, the utility would also provide a guaranteed market base for the new telecommunications service and a topology and rationale for universal service that is likely to win the favor of state regulators in light of their traditional, often statutorily mandated telecommunications policies. The model suggested in my most recent FORTNIGHTLY article ("White Knights for Fiber Nets: How Electrics Can Help Telcos Build Fiber to the Home", August 16, 1990) on fiber for electric-telco joint ventures — that the power company would become the "anchor tenant in the local loop" — would be equally appropriate for launching comparable joint ventures in microwave radio services.

The FCC has suggested, quite properly, that market relationships between incumbents and new entrants now arise to structure the evolution of microwave radio services. At the same time, a starting point also will have been established by which the electric utility could become both a major user of telemetry to achieve greater efficiency, and a major partner in the infrastructure critically needed to bring American telecommunications into the 21st century. Electric utilities should welcome this innovative proposal as a long-overdue recognition of their need to segue gracefully into telecommunications.

Steven R. Rivkin is an attorney in private practice in Washington, D.C.

REPRINTED FROM
PUBLIC UTILITIES FORTNIGHTLY
ARLINGTON, VA.
1992

White Knights for Fiber Nets: How Electrics Can Help Telcos Build Fiber To the Home

By Steven R. Rivkin

The long wars over least-cost planning in the electric industry could take a fortuitous turn: Investing in telecommunications to achieve demand-side management might become so cost-effective that power utilities can now be "white knights" helping local telephone companies accelerate building fiber-to-the-home networks.

The premise of least-cost planning is that electric utilities should be free to choose cost-effective ways to deliver service other than, but functionally equal to, selling electric power. To facilitate such options, regulators are increasingly approving rate incentives that aim to "level the playing field" between supply- and demand-side solutions, often with consumers and environmentalists cooperating enthusiastically.

One such demand-side strategy, though novel in concept and scale, could richly fulfill the purposes of incentive regulation by enabling utilities to overcome the wasteful disparities between electricity supply and demand. By using telecommunications and computers agressively, utilities can at last gain physical control over power distribution and open up two-way market relationships in real-time with their residential customers.

Aiming at unprecedented efficiency for the electric system, this approach will require the availability of high-quality data paths between the utility and widely scattered points throughout the local grid (distribution automation), reaching all residential energy meters (spot-pricing) and even inside residences to individual electricity-using appliances (home automation). Though telecommunication facilities adequate to these tasks are not to be had in local loops today, they will be integral to fiber networks in the future.

Local telephone companies (among others) are laboring to bring such networks into being, but they haven't yet found the key. The approach they prefer is highly politicized and problematic at best — to use the revenues from future sales of video services to pay for installing the fiber that can deliver those services. (Public utilities commissions require that rate-base investments must be "used and useful" in the regulated business, so telcos must be delivering some service that uses the special capacity of optical fiber in order to qualify the costs of deploying optical fiber in rate-base.)

The problems come from federal prohibitions, by statute and Federal Communications Commission regulation, of telco "cross-ownership" of cable television systems in local serving areas. Telcos cannot distribute video to their customers unless the rules are changed — or the telcos relax their opposition to merely carrying information for unrelated video entrepreneurs. Even though the cable television industry has garnered enormous public animosity for itself, the cross-ownership prohibitions are long-standing and deeply rooted in traditional antitrust doctrine. As yet, Congress shows no signs of definitively going along with the telcos, despite a major lobbying effort.

So the telcos are frustrated in their choice to raise the substantial capital they will need to pay for wide-scale fiber deployment. With the pace of local fiber installation slowed to a crawl by the need for regulatory cost-justification, residential fiber loops won't be completed for another generation (a horizon roughly equivalent to the normal schedule for fully depreciating existing copper networks).

Three Choices for Profit Opportunity

In the face of this impasse, utilities have three choices if they want to take advantage of the opportunities for profit and societal benefit that telecommunications-based demand-side management affords: They can find ways to use existing and improved telephone and cable television systems. They can open up data paths of their own, "bypassing" the local telephone network. And they can join with existing providers (a cable operator or a telco) to construct modern state-of-the-art — i.e., fiber — networks that can more efficiently support the utility's needs. All three approaches, if cost-effective, will merit tangible financial support under the new incentive concepts being implemented in public utility ratemaking.

Electric companies have never been seriously interested in sharing anything with local telephone or cable systems — though the three have had to work out sharing arrangements for poles, often painfully. There is a long history of failure in efforts to make telephone plant available for meter reading and other energy controls, failure due to the performance or reliability of telephone equipment, the cost of access to the public telephone system, and/or simple cultural and institutional incompatibility. None of this is surprising since, for all their proximity and comparability, utilities and telcos are built in complete isolation from each other.

Meanwhile, though cable television plants are theoretically useful for two-way data flows to aid utilities, this potential has never been other than merely theoretical. (My own expectations in this regard have not borne much fruit. See "The Coming Transformation of Electric Service: Entry into Cable Television," by Steven R. Rivkin and Virginia S. Carson, PUBLIC UTILITIES FORTNIGHTLY, February 4, 1982, p. 21.) Cable operators have consistently spurned using their coaxial plants for service applications other than one-way video entertainment. (In a few untypical instances, electric utilities have acquired cable systems as free-standing investments; in one case where a utility owned local cable systems, the utility pledged publicly that it would "never" use the cable system to read its own energy meters!)

There is, however, at least one serious and sustained project under way now that aims to use conventional telco plant to effectuate demand-side management. TransTexT, a project of ICS, Inc,. of Atlanta, scans to find if a residential telephone is not in use and then "shakes hands" with the electric meter, taking a current reading. The system's ability to make dramatic energy savings has been proven in field trials, but its speed has been shown to be limited by the design of the telephone plant. Additional steps are under way to assure TransTexT's viability as telephone plants evolve in the future.

Steven R. Rivkin, *an attorney specializing in communications, administrative, antitrust, and securities law, is a consultant to the U. S. Department of Energy and to electric utilities and telecommunications firms. Author of five books and numerous articles, he holds a BA degree in American government and a law degree from Harvard University.*

A second alternative for the utility is to bypass telcos by building its own customized data system. Again, a pioneering project is pointing the way. Metricom of Campbell, California, uses the electric wires between the residential transformer and a half-dozen houses as a local-area network (LAN) which interfaces with a wide-area network (WAN) of packet radios, one such radio assigned to each LAN. (The radios are in an unlicensed portion of the radio spectrum, are low-powered, and communicate by "spread-spectrum" techniques, so the WAN is a highly flexible and resilient medium.) Thus the utility has the data path it needs for distribution automation, spot pricing, and even home automation (since the LAN encompasses wiring inside houses) — all without any regulatory controls whatsoever. Coincidentally, the utility will also have acquired a transport system capable of carrying additional data for others and maybe even voice traffic in competition with the telco.

The final alternative — to join with existing local telecommunications suppliers to develop state-of-the-art fiber loops for the future — could be, at one and the same time, the most rational and far-reaching option.

By this approach the utility would be maximizing its leverage (before now unrecognized) to ensure that local fiber loops evolve in ways that will serve the utility's needs in terms of costs, reliability, and performance. Without incurring the burdens of trying to make conventional loop technologies work better or of trying to bypass traditional suppliers, utilities would have many assets to bring to the table if they would choose instead to negotiate cooperative ventures to build modern fiber networks.

Telcos the More Likely Partners, Unless . . .

In the rivalry between telephone companies and cable operators to deploy future fiber loops, telcos are by far the more likely partners of the utilities, as long as one-way video entertainment remains the cable operators' exclusive interest. If and when cable's motivation changes to encompass multiservice offerings, the advantages of partnering with utilities would probably be equivalent to those that now make the telcos so appropriate in such a role.

Complementing the utilities' needs for data to effectuate demand-side management, the telcos themselves have needs that utilities can uniquely supply. It has been said that the telcos have only two real problems in deploying fiber in the local loop: They can't power it, and they can't pay for it. Both problems are now seeking solutions that play to the utilities' expertise and resources.

A Possible Solution to the Powering Issue

The powering problem is inherent in the switch of technology from copper to glass fiber. Whereas copper telephone or coaxial cable plants communicate via a small electrical charge — which also powers the necessary functions of the distribution system and customer-premises equipment — fiber systems don't use electricity to communicate. They use light. So wherever physical work must be done to operate the fiber system, electricity must be separately and locally provided.

Powering is particularly crucial at two points — at the customer's premises to ring the telephone, light the display screen, and so forth, and at the "pedestal" or "curb," an interim terminus near several residences where new fiber and old copper systems interface. At the residence, the telco must find power, either from the power company or the residential customer, and finding power also means finding a way to pay for it that is acceptable both to customers and regulators. To reach the pedestal, telcos presently plan to string their own power lines from a central source of self-generated or purchased electricity. At both places, the home and the pedestal, the telco also needs back-up power — batteries — lest centrally generated power fail.

Ironies abound: At the residence, the telco needs power precisely at the point where the utility needs data — near the residential electric meter. Also, in powering fiber pedestals, the telco plans to "bypass" the power company to get electricity, even while the power company is contemplating its own "bypass" of the telco (à la Metricom's) to get data for distribution automation.

These ironies have as practical consequences that each entity could accomplish its purposes better by cooperating rather than by trying to go it alone. Illustratively, if having telecommunications controls succeeds in making the *utility* more reliable and responsive, then the *telco* may be able to minimize its back-up powering problem to the extent that centrally distributed power has been enabled to become more steady and reliable.

In this one particular way, the powering issue replicates larger strategic questions. Telcos need a regulatorily acceptable plan by which to charge their ratepayers for fiber installation. Utilities have an unmet (and often unappreciated) need for data services that completed telco fiber links could readily provide. Both entities are regulated by the same regulator, the public utilities commission, which is grappling with two crucial, unresolved ratemaking issues — how to pay for fiber-to-the-home and how to pay for additional utility plants.

These two issues might be solved by one common, insightful thrust — a linkage between the two local providers in which the telco undertakes to provide services to meet the utility's data needs as a key priority in the telco's fiber upgrade, and the utility undertakes to utilize those services in exchange for capital and/or other financial support. The regulator, separately responsible to the public for the soundness of both regulated industries, would facilitate this linkage by extending in a new context principles of incentive ratemaking to foster this new initiative in demand-side management. Utility contributions of capital in support of telco modernization would be sanctioned by regulators who, rather than acquiescing in a 35-year horizon for the completion of fiber networks, would foster a much more rapid timetable, expressly in order to bring their energy and environmental benefits into being widely and at an earlier date.

Fiber systems don't use electricity. They use light. So wherever physical work must be done to operate the fiber system, electricity must be separately and locally provided.

This utility-service dimension would effectively counter one simmering issue that, sooner or later, threatens to overtake the development of fiber-to-the-home — the prospect that such development can be stigmatized as "fiber-to-the-rich," those who live in new dwellings or have the ability to pay for fiber upgrades. In contrast, twinning telephone modernization with customer-oriented, environmentally conserving utility services would be conducive to promoting universal service — hitherto a key tenet of public utility regulation, mostly forgotten so far in planning for the renewal of local loops. This orientation would be sure to find favor among utility regulators. Moreover, the express rationale for linking the telco and the utility — to bring demand-side management into being at an unprecedented level of effectiveness — would capture much consumer and environmentalist support.

But, in finessing the telco-cable controversy, video applications would not be ignored. Rather, the rapid and comprehensive resolution of the controversy could follow, once fiber facilities are in place based on a financial foundation other than video, since the value of utilizing these facilities fully would be readily apparent. The fiber, most likely, would not be dark for long, and video would likely migrate rapidly to the fiber.

At least 32 telco fiber loops are in test demonstrations in the U. S. with not one yet directed toward electric utility demand-side management. That omission should be . . . remedied.

Confirmation of State Commissions' Traditional Role

Moreover, having played a key mediating role in bringing fiber networks into being, state public utilities commissions would be confirmed in their traditional function overseeing intrastate telecommunications. These regulators will likely welcome the orderly atmosphere to plan for the long term which the initiative of two regulated utilities has created. One such model for the telecommunications industry — duopolistic competition — could emerge out of the participation of the two regulated entities in the founding partnership, should the monopoly model under which the facility came into being no longer reflect the public interest. In any case, commissions will be well positioned to deal with two of their classic concerns — avoidance of wasteful duplication and preservation of universal service — and to begin to identify what other regulatory philosophies are appropriate for the world of fiber.

So how should such an evolution be initiated? First of all, it is essential to recognize that the key premise in the joint undertakings suggested here has yet to be conclusively established — that telecommunications and computer controls will produce major savings of energy, plant, and the environment. While few doubt the probability that modern telecommunications can be very useful, some question whether the savings will be great enough to justify the costs and effort involved.

On the other hand, preliminary results are tantalizing; TransTexT, for one, has documented a 23 percent drop in electricity peak consumption with the utility making more money and the consumer spending less. Both TransTexT and Metricom are in the midst of pilot demonstrations. It's time now to establish similarly the cost-effectiveness of the third alternative telecommunications strategy open to utilities, building fiber loops jointly with telcos. At least 32 telco fiber loops are in test demonstrations in the U.S. with not one yet directed toward electric utility demand-side management. That omission should be immediately remedied, preferably through more than one exploration of different equipment designs and, most assuredly, by tests examining the many applications of telecommunications which are conceivably relevant to utility demand-side management.

Showings of cost-effectiveness will be essential to trigger one of the key premises of this article, that telecommunications partnerships ought to win rate incentives for power companies, being only an extension (logical but also very powerful) of the other demand-side initiatives that are gathering commission approvals. Utilities' out-of-pocket costs for such tests would be clearly recoverable in rates as expenses, but the possibility of making capital investments also ought to be evaluated for appropriate inclusion in rate base, along with the extent to which the utility should ultimately be able to profit from its investing in a general-purpose telecommunications facility. "Making Electric Efficiency Profitable" by the Hon. Stephen Weil, PUBLIC UTILITIES FORTNIGHTLY, July 6, 1989, p. 9, provides an excellent discussion of the ways regulators are rectifying the traditional bias against demand-side management in ratesetting.

The Shareholders' Stake

Surely the prospect that utility shareholders might earn profit off a timely investment in telecommunications facilities is not out of the question. Public utility regulators have long wrestled with the modalities of permissible diversification by regulated industries and their unregulated affiliates. It has always been easier for a utility to diversify into a wholly unrelated business far away from its area of regulated operations than it has been to enter businesses in its home markets that may be functionally related to the distribution of electricity. Now, under the rubric of incentive regulation, cost-effective demand-side investments that are the functional equivalents of energy production are becoming elegible, as they should be, for investment by regulated utilities. Joint undertakings with telcos may prove to be well within the mainstream.

Nor should the prospect of the utility profiting be a cause of concern to the telco. Rather, utilities could be useful and timely allies to the telco in completing a difficult task (without the anticompetitive taint of two telecommunications providers joining together). Like commercial real estate developers, telcos need strategic allies to mitigate the risk they face in committing their energies and capital in an uncertain market. Developers try to control their risk early on by lining up "anchor tenants" — stores like Bloomingdale's or Nieman Marcus or Nordstrom — that are sure to draw other valuable tenants and well-heeled customers. Electric utilities can play a similar, catalyzing role as the telcos set out to build fiber networks.

Moreover, as the "anchor tenant in the local loop," an electric utility would merit a slice of the profits as a reward for its ground-floor participation. Regulators might be properly considerate of utility shareholders in such a situation, especially if the relationship between the telco and the utility frees the utility from the downside risks of losses, as is often the case, analogously, with anchor tenants of shopping malls.

In the last analysis, joint ventures in local fiber networks could make good business sense for both the telcos (which get their plants modernized and financed from rates) and the utilities (which get the telecommunications support they need on terms they can afford and trust). But greater yet will be the benefits to the public, the ratepayers of both companies, who will gain access to new worlds of comfort, information, safety, and value.

The Economics of Fiber to the Subscriber

By Hal Selander

Many claims have been made about the economics of fiber-to-the-subscriber. Fiber proponents argue that serious deployment will soon begin. Others argue that fiber-to-the-home is a 21st century technology that will cost over $450 billion to deploy. Who's right? And what are the implications of the answer to this question for public policymakers interested in realizing the benefits of broadband fiber technology?

The truth lies between these extreme views. There is no doubt that fiber-*almost*-to-the-home, or fiber-to-the-curb, for existing telephone services will become economical for new builds within the next few years. But the deployment of fiber systems may be stalled on the way to the home. Network-based service providers lack strong incentives to deploy fiber technology expeditiously and systematically. Without changes in public policy, the prospects for fiber to the subscriber for broadband switched video service — the type of service for which fiber optic technology is optimally suited — are distant at best.

Fiber-to-the-curb systems will be deployed faster because they cost less. Such systems reduce the cost of deployment by sharing electronics among many homes and using copper and/or coaxial cable in the "drop" to the home. They allow only for the provision of narrowband telephone-type or broadcast video services available today, not switched broadband services of tomorrow. Also, not all fiber-to-the-curb systems provide a logical migration path to switched broadband services.

The costs of *narrowband* fiber-to-the-curb systems are increasingly attractive. Yet, without the incentive of providing broadband services, the economics of these narrowband systems are not sufficiently compelling for their rapid deployment. With fiber network costs only at parity with copper, any rapid fiber deployment must presume that policy changes at the federal level are imminent, thus allowing the rate payer to reap the benefits of fiber in terms of new services, besides immediate efficiencies from network modernization.

Broadband fiber-to-the-home systems — that is, systems to the home that can provide two-way switched video services — are currently beyond reach, because their installed first costs are much higher than that of existing copper technology. Today, broadband fiber systems are on average about three times more

Hal Selander *is a senior manager at Braxton Associates, a division of Deloitte & Touche. His consulting practice focuses on business strategies for emerging technologies. Mr Selander received his BS degree in chemical engineering from Purdue University, and his MBA degree from the Harvard Business School.*